The Engineering Features of "Built-In" Lighting

By A. L. Powell and Alston Rodgers
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Nela Park Engineering Dept.
General Electric Co.

REPRINTED FROM

Lighting

November, December, 1930; January, 1931

A.I.A. File No. 31F1

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Note: The Authors consider "built-in" lighting as that which must be designed as a component part of the building, the sort which in general cannot be applied to a structure that is entirely finished.

FOR many years lighting engineers have been advocating the practice of designing the lighting as a component part of the building. They have realized that it was incorrect practically to finish a structure and then to begin to plan the illumination. Many times, by a slight change in the location of supporting members, or by the provision of space for the placement of illuminating equipment, it is possible to obtain effects that are quite out of the question if the building is nearly finished before lighting is considered.

The architect or decorator should vizualize the finished structure and the effect he is desirous of creating. He should make sure that it is physically and economically possible to obtain the kind of illumination and the lighting effect which he desires. Fortunately, with the growing acceptance of the modern style, we are finding a greater and greater appreciation of this principle, and the up-to-date architects are planning their lighting along with the other elements which are component parts of the edifice.

Up to now, there has been comparatively little published data on this new practice and in this, and succeeding articles, the authors have attempted to set forth some of the underlying principles and certain fundamental facts which apply. An attempt has been made to analyze the various methods which may come under the heading of "built-in" lighting. In general, this expression has been assumed to mean the kind of lighting which must be planned and partly installed before the room is completely finished in contra-distinction to the type of luminaire which is hung pendant from an outlet. Of course, no fine line of demarcation can be drawn, and many of the methods suggested fortunately can be applied to the finished building.

In the accompanying sketches are presented some suggestions as to the mechanical means of producing the desired effects. It is not believed that these suggestions by any means cover the theme, or that they are complete in detail. They are incorporated merely to indicate the method of approach. Certain suggested shapes and arrangements are shown with a given means of mounting; other combinations with other methods of support. Of course it will be understood by everyone that these features are interchangeable and are not intended to show that a given scheme is the best for a certain combination.

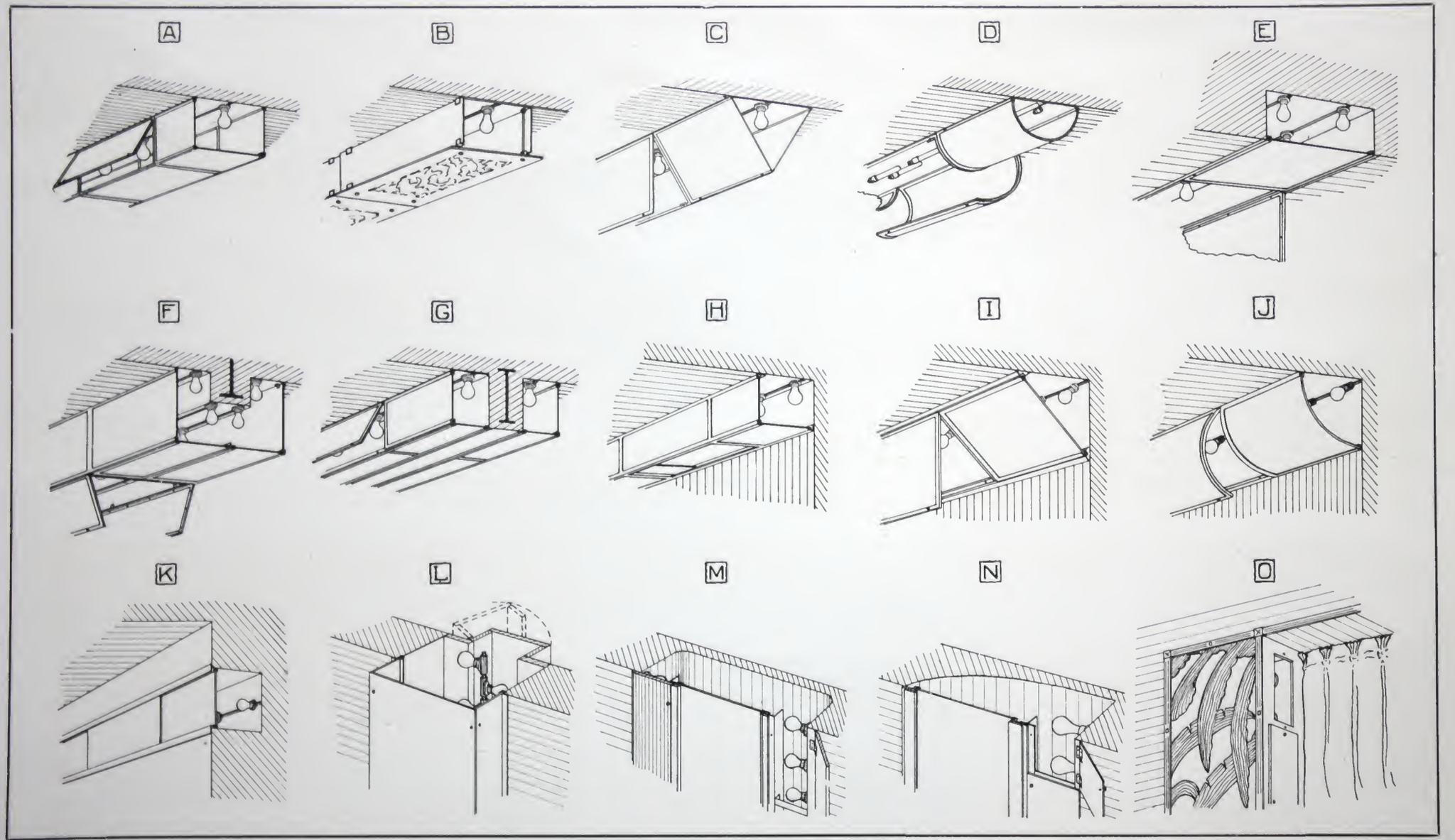
At left: White glass cubes are used to outline this window. Colored lamps of various tints produce an interesting gradation which can be changed to suit any decorative scheme.

Center: Installation of flush light box 12" wide, 8" deep and 6 ft. high beside curtained window. Amber and opal flashed sheet glass is used. A metal overlay, made by cutting .02" sheet copper with "Cutall" machine, gives an air of distinctiveness. A verde finish to this is obtained by painting the surface with a mixture of salt and vinegar. 25 watt Mazda lamps on 6" centers give a satisfactory surface brightness.

At right: Around this window is placed a very simple box, 7" wide x 8" deep. 15 watt Mazda lamps are used on 6" centers. Relamping is accomplished by removing the wooden strip at the side. Panels of flashed crystal and opal glass, 17" long, are used. These are separated and held in place by narrow metal binding strips.

Light Boxes

A form of luminaire that has come into being with the vogue of so-called modern art is the light box or luminous panel. This has many very interesting features and unquestionably will survive, regardless of whether the present decorative style continues. It is very logical to light certain interiors from the side rather than overhead for we can imitate the direction and distribution effects of natural lighting. Luminous panels or boxes have been applied in geometric patterns on the ceiling, as well as on the walls. There is no end to the possibilities of the



Some Suggested Arrangements for the Mechanical Features of Luminous Boxes Employing Flat or Curved Sheets of Diffusing Glass, Plain, Etched or Otherwise Decorated.

A—A rectangular box, in which the glass is supported by a relatively inconspicuous metal frame work with hinged sections at intervals for relamping and maintenance.

B—In this case the bottom plate extends beyond the side panels. A rod, on which clips are fastened, supports the side panels, and ornamental nuts carry the weight of the drilled bottom plate. Side panels are over-lapping and relamping is accomplished by sliding these past each other.

C—A triangular box, similar in construction detail to the square box shown at A.

D—A semi-cylindrical box with alternate sections hinged.

E—Flush ceiling box with double row of lamps for wide panel. Hinged metal frame work provided for maintenance.

F—Luminaire of more elaborate construction built around projecting ceiling beams. A double door arrangement is here suggested.

G—For deep ceiling beams this construction is probably the most preferable. Such an arrangement has advantages in the large room in avoiding numerous light sources in the ordinary field of view, for projecting beams tend to shield successive light sources.

H—Square box at junction of side wall and ceiling with frame work in which lower panels rest. These may be lifted and slid to one side.

I & J—Simple flat and curved corner boxes with hinged sections.

K—Horizontal flush side wall box with sliding panels arranged in grooves, similar to those used on certain types of bookcases and showcases.

L—Protruding vertical wall box. This extends through the wall and maintenance is accomplished by having a hinged door in the form of a pilaster on the opposite side of the wall.

M—Arrangement for indirect lighting of very shallow box, or where the glass does not produce adequate diffusion. The side panels, which cover the lamps, are moveable.

N—Single row indirect lighting with curved background for uniformity.

O—Light box for door or window frame, employing thin metal filigree or overlay. Maintenance is accomplished by removing screws holding hand-hole covers of metal or wood veneer.

use of these for emphasizing form and line.

At first, there was no engineering skill whatever applied to the design of luminous boxes. Constructors and decorators made some sort of recess where they desired to have the light placed and then covered this with the cheapest material at hand. This generally happened to be rough crystal glass, either sand blasted or acid etched. Everyone familiar with lighting appreciates that roughed or frosted glass is at best a very poor diffuser and, instead of obtaining a uniformly luminous surface of pleasing texture, a glaring, badly spotted effect resulted.

Obviously, the uniformity of brightness depends on several factors, viz: the kind of glass used; the spacing of the lamps; the depth of the box or distance of lamp from the cover; and the reflection factor or color of the inside of the enclosing box.

Frosted glass, even if roughened on both surfaces, is never very satisfactory. Some sort of really diffusing glass should be used. White Opal glass is now available in thin sheets. White flashed or cased glass with its thin layer of opal is even better for it has less absorption for a given diffusion, due to the extreme thinness of the opal layer. Colored Flashed glass, consisting of the opal layer on a base of amber tinted glass, is also very effective, and this combination gives a warmth to the resultant light which is indeed pleasing.

Some of the carved and etched glasses are very interesting but, in general, these depend on frosting for diffusion and are not wholly satisfactory. A combination of the carved glass with a flashed opal diffusing plate is better suited. Where it is necessary to use frosted or carved glass, it is sometimes possible to place the lamps out of sight at the sides of the box, have their light strike the back of the box, and illuminate the glass through indirect reflection. This, of course, involves absorption and, generally speaking, the resultant output will be less than if the panel is directly illuminated and is diffusing in itself. It also involves more complicated construction.

Assuming that a simple box covered with the glass plate is used, if *sand blasted* or *acid etched crystal glass* is employed, inside frosted Mazda lamps placed 6 inches from the glass must be on 3 inch centers, if a general appearance of uniformity is to be secured. If lamps can be placed 12 inches from the glass, they may be on 6 inch centers.

A suggested arrangement of glass panels and wiring for a niche on a building exterior.

Several forms of built-in lighting are used in this Fifth Avenue Shoe Shop. On the ceiling may be seen symmetric areas of amber tone glass boxes. On the side wall in the rear, semi-direct wall pockets; and in the foreground is a novel adaptation of cove lighting.

If *flashed opal glass is used*, no noticeable variation in brightness is obtained with the following spacings:

4 inches from glass— 6 inch centers
6 " " " — 9 " "
8 " " " —14 " "

The wattage of the lamp makes practically no difference in the uniformity of brightness.

With a high reflection background, it is possible to have a wider spacing for a given distance of the lamp back from the glass and still have uniformity.

Assuming a maximum ratio of brightness of one to two, the ratio of the distance of the lamps back of flashed opal glass to the spacing of outlets must not exceed 1 to 3½ if a background with a reflection factor of 70% or better is used, but must not be over 1 to 2½ if the reflection factor of the background is low, in the order of 30%.

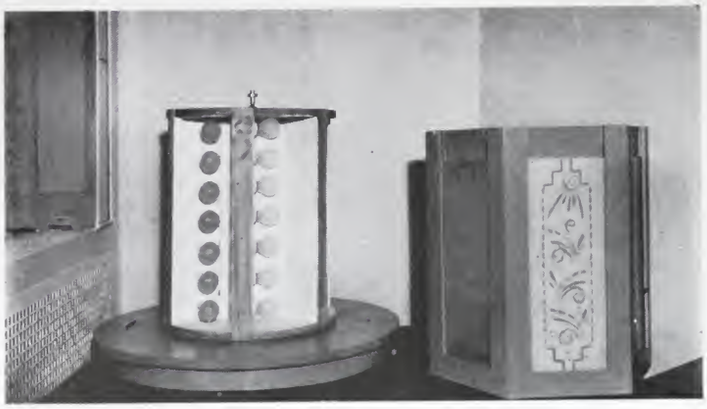
As considerable heat is generated in an enclosed space, provisions should be made for ample radiation or ventilation. It is desirable to use porcelain sockets rather than those having fibre in their makeup and asbestos covered wire, or at least some form of slow burning insulation is essential. Some simple mechanical means of reaching the interior of the box for cleaning and relamping should be provided in the design.

If the glass has dividing strips, it is desirable to make these coincide with the somewhat darker areas between lamps. A very pleasing decorative touch is added by

the use of a suitable filigree design of thin metal applied close to the glass. Metal deposit on the glass itself is another method of accomplishing this effect.

The light output of the complete unit will, of course, depend on the transmission of the glass used, the reflection factor of the back and sides, and the placement of the lamps.

With a good white background and reasonable pro-



A device for demonstrating the effect of lamp spacing, distance from the glass, and color of background with various types of diffusing material. Six different glasses may be inserted in the outer drum, and with the inner partitions, spacings of 3, 6, 9 and 12 inches at distances of 3, 6, and 9 inches back from the glass, can be obtained.

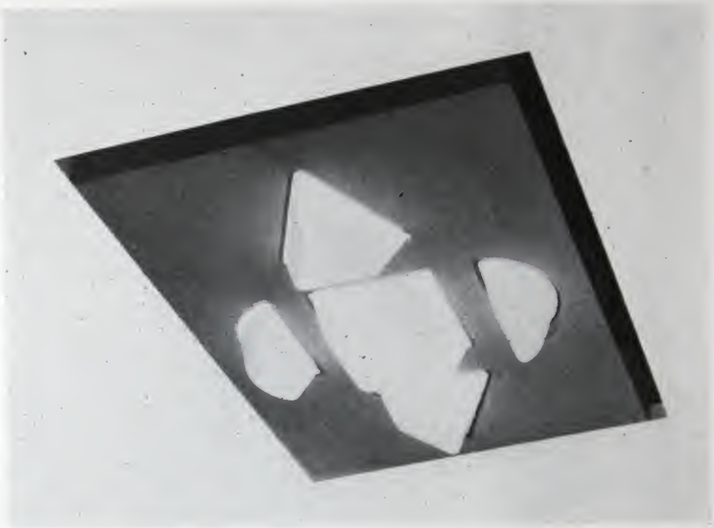
portions of the box (say 10″ wide by 8″ deep) using flashed opal glass, the output should be in the order of 40 to 50% of the bare lamp lumens. The distribution of light will be that of a uniformly bright plane surface —in other words, a cosine curve with the maximum intensity normal to the surface. The RLM Reflector gives a distribution of this type.

With frosted glass, the output will be slightly higher, but this gain does not compensate for the poor appearance. With dark background and narrow deep boxes, the output will be proportionately less.

Geometric Luminous Forms

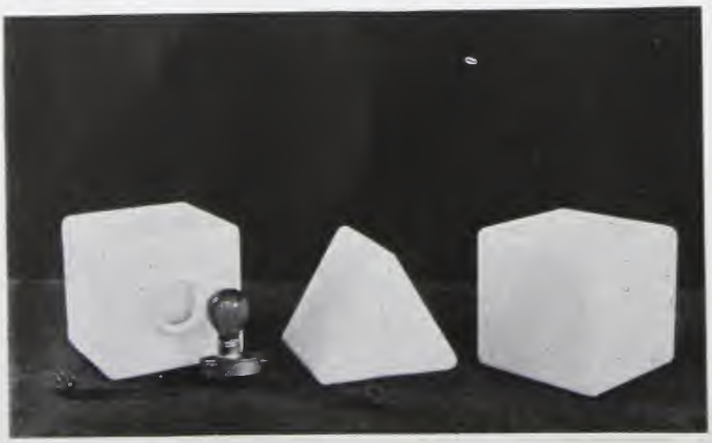
Some very interesting lighting effects are produced by mounting on the ceiling of an interior geometric forms of enclosing glassware, arranged in patterns which emphasize certain features of the decoration.

There are being imported from Germany a line of enclosing units known as "Cubelites." These are made of



An experimental installation of glass boxes arranged in a geometric pattern. A great variety of effects can be produced in this manner and any decorative scheme incorporated in the supporting parts of the luminaire.

flashed opal glass and are available in different sizes and shapes. They are provided with standard lip fitters of various sizes. A single lamp, or a group of lamps, may be used in individual cubes. Colored lamps are especially effective for when these are used the glassware is uniformly luminous in the most delicate pastel tints. In addition to the application of such units for overhead



"Cubelites" of various shapes are most useful for built-in lighting. A simple arrangement for wiring and connecting is standard. Elaborate installation of these units is to be seen on the S. S. Bremen, of the North German Lloyd Line. Above: A series of geometric glass shapes which have been placed on the market by the Gleason-Tiebout Glass Company of Brooklyn, N. Y. These are held in place by hinged metal frames.

Luminous vertical wall panels used as a component part of the decoration of a living room done in the modern French style.

lighting, they may be placed one above the other to form columns, arches, and lintels of glass.

The cubical form is available in 6, 8, 10 and 12 inch sizes. There are also special forms as follows:

Hemispherical	9 inch
Cheese shape	9 "
Triangular prism	8 "
Hexagonal prism	9 "
Truncated prism	9 "
Oblong prism.....	7 x 11 x 4"

One of the leading American glassware manufacturers has made available four "dish shape" pieces of glassware for architectural lighting. There is a square, 12" on the side; a right angle triangle 12" on two sides; an equilateral triangle 12" on the three sides; and a half circle 12" on the straight side. These are all 4½" deep and have slightly tapering sides. They are all made with a lip and a simple metal hinged framework can be used to support them. One or more lamps may be used in each box. This glassware is supplied in crystal or polycase opal, and can be cut, carved, etched and decorated with special designs. A thousand and one combinations are possible through the use of this new device, and the uniform size of one side permits their use in combination on the ceiling, walls and in suspended fixtures. They provide a wealth of material for the exercise of ingenuity in original design.

Another American manufacturer lists pressed square and hemispherical bowls in French crystal glass with various styles of deeply marked decoration which can be used in the same general manner.

The utilization factors for such lighting systems are comparable with those for enclosing units of the same general type of glass and will vary with the amount of applied decoration.

Coves

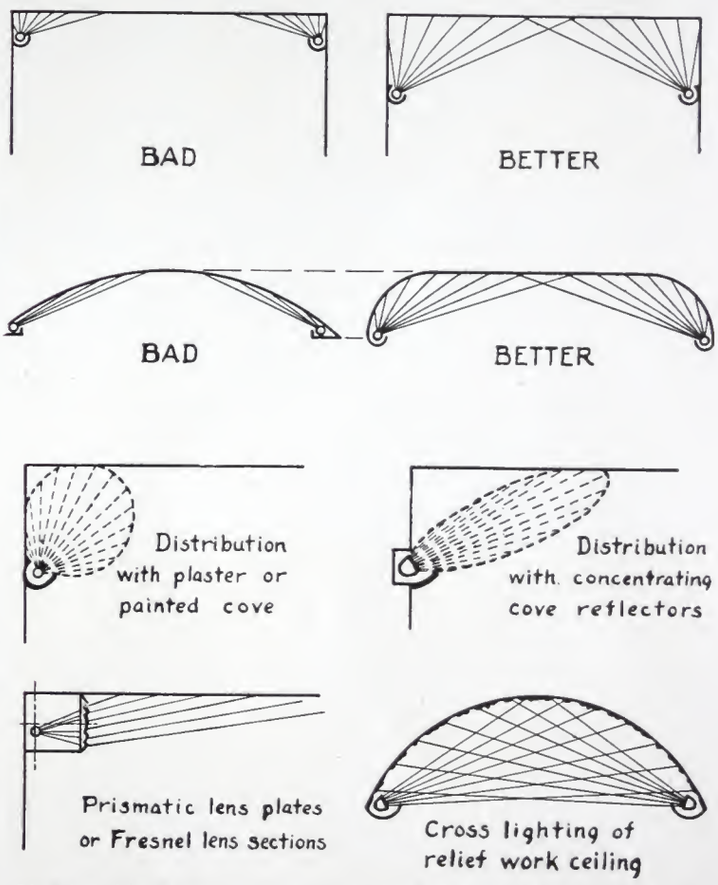
One form of "built-in" lighting, while not essentially new or novel, yet a very important element in a consideration of the subject as a whole, is the indirect trough or cove. If this system is to be satisfactory, it should be carefully planned and provisions made for it before the structure is completed.

Obviously the most pleasing effect is produced when the ceiling is relatively uniformly lighted, at least does not appear "spotty". Spotty effects are produced where lamps are so placed relative to the surface to be lighted that the light does not have a chance to "spread" before it strikes the surface. For example, it is impossible to obtain a good effect if the width of the ceiling is great, if it is relatively flat and the cove is close to it. For the best lighting effect we should strive for the maximum rise to the center of the ceiling and, further, the section close to the lamps should be nearly perpendicular rather than following the sweep of a circle, as indicated in the accompanying sketch. This design tends to avoid the bright spots adjacent to individual lamps so often noticed in cove lighting. By designing the curvature in this manner a far better effect can be secured with no greater total "spring" or rise.

Too often in a desire to save on initial cost, cove lighting is installed with receptacles and bare lamps mounted in a rough white plaster trough. At first, the plaster reflects the light well in a diffuse manner, but with the accumulation of dirt its minute pores soon fill up with non-reflecting material which cannot be dusted or washed off. Frequent painting is essential if the efficiency of the system is to be maintained. It is evident that reflectors with surfaces that can be effectively cleaned are more economical in the long run.

There is another very important point in favor of suitable reflectors for this service, particularly where a wide area is to be lighted. No matter what shape one may make a plaster or painted trough, since it acts by diffuse reflection alone, the distribution of light will remain the same. Its distribution curve is always more or less circular in form. Everyone can see that if the light must be sent out to the center of a wide area, it should be emitted in the form of a narrow sheet. Hence, concentrating reflectors acting by regular reflection (mirrored glass, prismatic glass, or polished metal) are necessary. The more flat and wider expanses, of course, require greater concentration of the beams. One scheme which has been used abroad and in the U. S. for spreading the light out across the ceiling employs sections of prism glass similar to the familiar Fresnel lighthouse lens. This produces a sheet of light in a narrow angle.

In planning the trough itself, sufficient space must be



Sketches illustrating some of the fundamentals in the design of cove lighting, details of which are discussed in the text.

provided for the accommodation of the reflecting equipment and to permit its being adjusted. Sometimes the wall directly in back of the ledge on which this is mounted must be cut away, in other words, a recess made.

It is ridiculous to install cove lighting in positions where it cannot be easily and safely reached from a ladder without providing some means of getting at it from the rear for relamping and cleaning. Lamps will burn out in time and dust and dirt does certainly collect. There are hundreds of jobs throughout the country, particularly in theatres and public buildings, which were most satisfactory immediately after the building was finished that are now a disgrace to the lighting industry because the architect did not think of the future. Coves are located in places which cannot be reached without the building of very costly scaffolding. They are, hence, practically never cleaned or relamped and conditions eventually become so bad that the system is entirely abandoned. Examples might be cited of some of the most famous buildings in the country where this has happened.

A cove properly proportioned as to depth and width, combined with a ceiling of suitable curvature, makes possible indirect lighting without streaks, spots or great variations in brightness. These effects often result when lamps are too far apart, too close to the ceiling, or the ceiling too flat and too wide. In this instance the uniformity of illumination of the ceiling is noteworthy for the slope of the ceiling rises sharply at the edges and the spring is relatively high.

Now as to the utilization of light from such systems. This will, of course, depend on the color of the ceiling, the general proportions of the room and the sort of reflecting equipment used.

With a very light colored ceiling, (reflection factor 70 per cent or better), and a room of reasonable dimensions, 15 feet high, 20 feet wide and 50 feet long, an ordinary plaster cove in good condition would have a coefficient of utilization in the order of 18-20 per cent. If efficient mirrored glass reflectors are used under the same conditions, this factor might be as high as 25 per cent. For other color treatments these values must be reduced in the ratio of the relative reflecting power.

This night view of the Viking Room, Haddon Hall Hotel, Atlantic City, indicates the pleasing effect produced by totally indirect lighting from inconspicuous side wall boxes. Here the ceiling is in the form of a flat curve with a two foot rise at the center, and is light cream color. The room is 45 feet long, 36 feet wide and the ceiling 20 feet in height. Above the dark wood wainscoting 8 feet below the ceiling are three simple boxes on each side. These contain six 200 watt Mazda lamps each in mirrored glass reflectors specially designed for this service with a projecting lip or shield (X-Ray EC-68). The double brackets with inverted reflectors and small lamps are for emergency and decoration.

Sometimes when the ceiling has relief work in its structure, it is desirable to arrange the reflecting equipment in such a manner that the units on one side direct their beams to the opposite side rather than, as is generally the case, attempting to light the half nearest the source. Of course, such a scheme as this necessitates a relatively high vaulting. This general system of lighting has many ramifications. It might even be considered as applying to the scheme where the light is directed to the opposite wall rather than the ceiling for reflection to the work. Such an arrangement as this has been used in the Church of the Heavenly Rest, which was described in the March, 1930, issue of LIGHTING.

Indirect Lighting and Semi-Indirect Lighting From Side Wall Luminaires

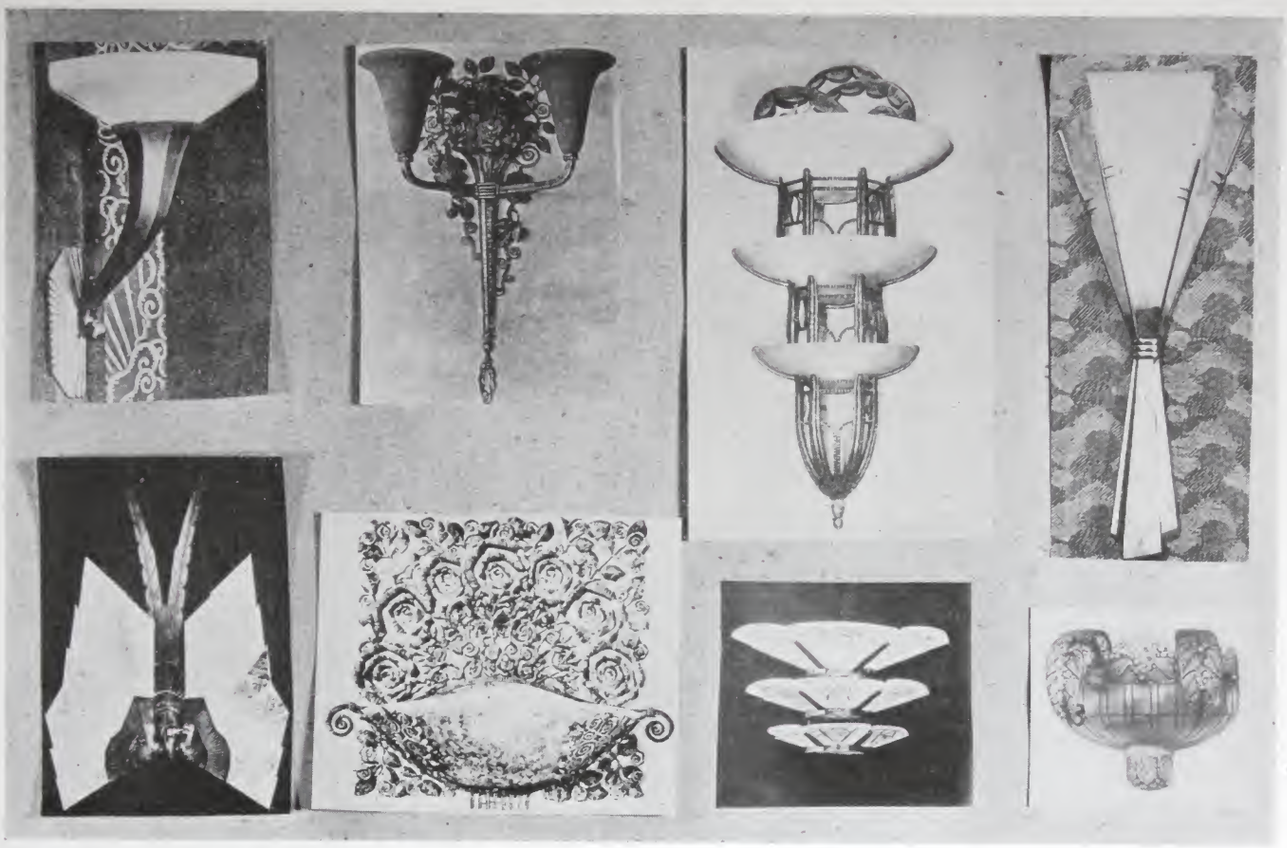
There are many conditions where it is undesirable to use ceiling fixtures, where the construction will not permit the installation of a cove and where indirect floor standards of the various types are out of the question. In such instances lighting must be accomplished from side wall luminaires. If a moderately high level of general illumination is to be secured, the traditional types of side wall brackets are most ineffective. If one places in a candle fixture lamps large enough to furnish the necessary lumens, the installation creates severe glare, particularly because the outlets are relatively low and in the direct line of view. Most types of shades for diffusing the light and protecting the eye obtain their softening effect largely through absorption, so generally speaking, when one shades wall brackets the resultant illumination is very materially reduced.

A side wall luminaire to furnish useful general illumination must be so constructed as to send the light by reflection up and out. In other words, it must be of an indirect character. Such equipment may be opaque or translucent and hence luminous. In the opaque class, reflectors and lamps are concealed in some sort of box or enclosure. This may be rather extended in character, as shown in one of the accompanying pictures, or may consist of a single unit. These boxes may be incorporated as an integral part of the wood or plaster work, or they may be disguised in various manners. Sometimes artificial foliage has been used which, hanging from the edge of the box, gives the effect of the typical flower box.

It is possible to incorporate efficient opaque reflectors in a box of some translucent material and then use a few low wattage auxiliary lamps to obtain the effect of a luminous box.

So-called semi-indirect lighting from side wall outlets is coming more and more into favor. Whatever material is used for these pockets, boxes or urns should be very dense, reflecting the light well and transmitting but little. This will keep the brightness at a low order. Unfortunately, in a number of examples that have come to the authors' attention, thin, poorly diffusing, frosted glass has been used. This is far too bright for the best effect and the good qualities of this system are nullified. Dense white art glass, such as Equalite, heavy density cased glass, dense opal glass, alabaster or marble and even translucent china find application here. The exterior surfaces can be toned, etched, tinted and otherwise decorated, but the interior should be left a pure white to reflect the light well.

There is no limit to the wide variety of designs or arrangement of parts which can be used for this system and it offers a very fruitful field for the ingenuity of the designer. Some French concepts are grouped in one of the pictures.



A few representative types of semi-indirect side wall luminaires by various French manufacturers. These indicate the wide variety of design possible with this general system.

One feature that requires attention in indirect lighting from side walls is the so-called "splash" of lighting which strikes the wall directly in back of the fixture. This results from the proximity of the lamp to the lighted surface. Some of the opaque reflectors are provided with a lip or shield which extends out over the lamp and reduces this direct light. This arrangement quite appreciably cuts down the total output. Another scheme which might be used is the placing of a prismatic refracting plate across the mouth of the reflector which will send the light outward. In some designs, as will be seen in the French group shown above, an ornamental back plate of wrought iron or some other material is provided. The effect of this splash of light is broken up and the high light only serves to enhance the ornamental detail. This scheme also offers opportunity for development.

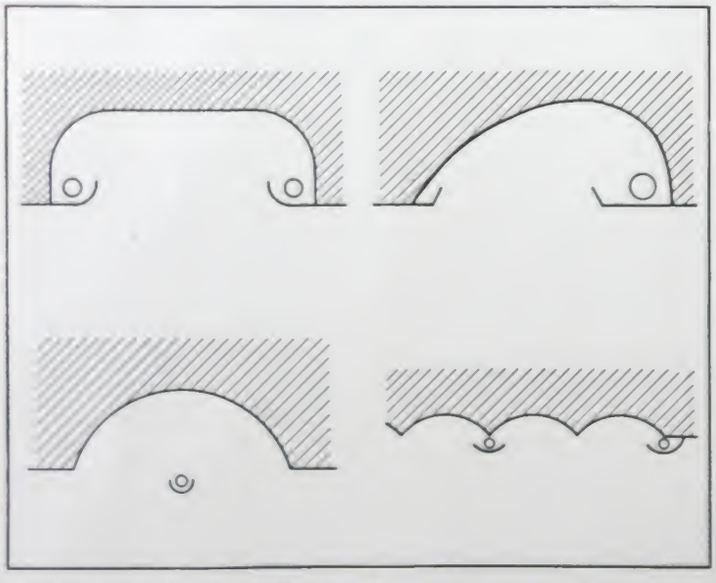
In the ball room of the Panhellenic Building, New York City, general illumination is provided from fifteen side wall boxes which are placed four feet below the 20 foot ceiling. These are of plaster, which is finished and decorated to harmonize with the room as a whole. Reflecting equipment and lamps are concealed within.

The main banking room of the Industrial National Bank of New York City is lighted from lamps in ceiling coffers. The entire ceiling is made up of octagonal caissons and the outer row of these in any section becomes the lighting units. Suspended by a bronze framework are two parallel frosted glass plates about 2 inches apart, the upper being slightly larger. The size is 28 by 36 inches and 600 watts of Mazda lamps are placed in each section.

Right: A luminous side wall niche. Here the overall dimensions of the lighted area are approximately 13 feet by 5 feet. The back wall is in the form of three flutes and is covered with silverleaf. In front of the peaks of the flutes a metal grille work carries a strip of amber diffusing glass behind which, in turn, is placed a series of tubular Mazda lamps.

Lighted Niches

Along this same general method is the idea of placing lamps at the bottom of a side wall niche with a protecting and extending lower lip or parapet. The high light or splash is confined to the recessed niche which becomes brilliantly luminous and appears quite natural and pleasing.



Sketches showing in section possible arrangements of lamps and reflecting equipment for lighting wall or ceiling niches. Diffuse or specularly reflecting material may be used for the background depending on the effect desired. With some of the designs a grille work of metal may be used to advantage to cover the opening, or decoration may be applied to the background.

As mentioned in the above paragraph, recesses may be made in the side wall and lamps placed at the bottom of this for a general indirect lighting effect. A recess of the desired size and contour may be made in the side wall and light directed toward the back of this, producing a sort of false window effect without glass. Lamps may be concealed around the edge of the recess and their light reflected toward the back wall and thence out into the room.

Another arrangement might place the lamps behind some sort of shield which may be either opaque or translucent. An example of this scheme is shown in one of the illustrations. The back of the recess may take any desired curvature. Some possible combinations are shown in the sketch. The whole wall may be made up of a series of niches to which the light is reflected from narrow sources—this scheme is used in the lobby of the Chrysler Building. This arrangement, in all its variations, could also be applied to the ceiling, if desirable.

Lighting From Ceiling Coffers

In many forms of architecture it is found desirable to break the sweep of the ceiling by means of square, hexagonal, octagonal or round recesses which are known as coffers or caissons. These have a general shape which is similar to that used in common types of reflecting equipment, such as the RLM dome. Therefore, if we put light sources up in these pockets, the flux will be distributed in a relatively effective manner. It is generally not

desirable to use unshaded or bare lamps here and many expedients may be used to enlarge the light source, introduce diffusion and add an element of decoration. As shown in one of the figures, a very simple method is to suspend beneath the lamps a sheet or disc of diffusing glass. This may be ornamented by a metal grille or other applied decoration. Sometimes this may be well above the surface, in the case of a deep coffer, or may be placed below the ceiling line thus giving some spread of light on the adjoining areas.

Another arrangement places the lamps within boxes, which follow the general outline of the recess. Sometimes small boxes are used in the corners rather than one large box at the center.

The coffers themselves may be individually lighted by the indirect method, and their surface becomes a secondary light source. These lamps for indirect lighting may be placed in the center and hidden by a suspended shield, or may be mounted in a narrow trough, which may be opaque or translucent, around the edge.

Another variation is shown in one of the sketches. Here the circular coffer is lined with a series of horizontal diffusing glass rings which are made luminous by lamps above.

The coffer may be quite plain and its opening covered by a plate of pressed glass in the form of a grille. Some very pleasing designs of glass for this service have recently appeared on the market. This is in a sense a form of luminous box.

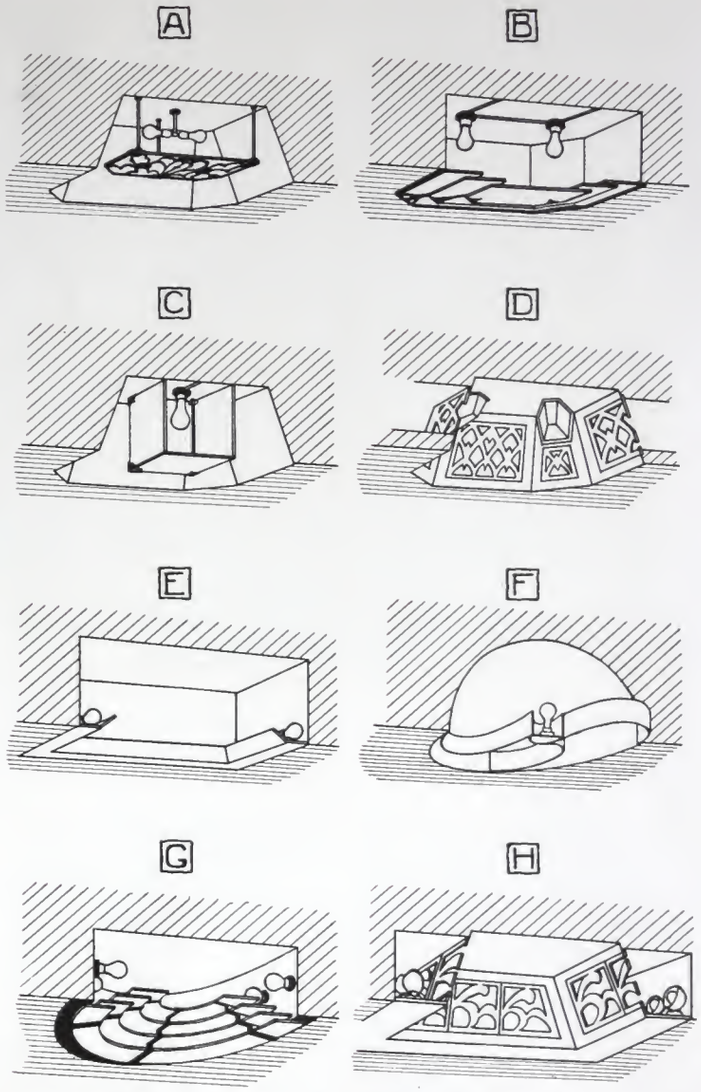
Still another variation consists in making the sides of the coffer of this glass grille work and placing the lamps in back of it.

If the recesses are painted in brilliant colors some extremely interesting and striking effects are secured. The resultant illumination is not badly distorted as to color, provided care has been taken in balancing the primaries when painting, but there seems to be a peculiar charm to the illumination since it is made up of a multiplicity of colored reflections.

It is apparent that the coefficient of utilization of such systems as this will depend on many factors, the sort of glass used, the colors employed for decoration, the shape of the box and arrangement of lamps. If a pure white coffer is used and the glass has a high transmission, as efficient lighting as produced by the glassteel diffuser (which operates on the same general principle) can be secured. As color is introduced on the surface and tinted glass is employed, the illumination per watt will fall off materially. When the indirect scheme is used this will be still lower.

Modern architecture presents many problems. One of these is artificial ventilation for conditioned air. A practice is growing of supplying this through perforated sides of ceiling coffers. This has much in its favor and the combining of artificial lighting and artificial ventilation in one unit is most logical and a natural development. Where currents of air circulate around lighting equipment there is likely to be a somewhat excessive accumulation of dust, and care should be taken to see that adequate maintenance is provided where these two elements are so closely coordinated.

Most of the built-in lighting that has been discussed up to this point has been designed to furnish illumination of a utilitarian sort as well as decoration. There are, however, many potential applications of artificial illumination which have as their primary function decoration and such illumination as may be supplied is merely secondary. It is legitimate to furnish "light to look at rather than to see by" for there is a certain intangible quality with decorative effects produced by light that is totally absent in decorations by pigments. Colored light flux has life and beauty such as is obtained through no other medium.



Sketches showing arrangement of lamps and diffusing equipment for ceiling coffers. A. A flat sheet of glass suspended by rods with clamps below the lamps and above the level of the ceiling. This may be decorated or covered with a metal cutout which shows up in silhouette. B. One or more plates of diffusing glass suspended slightly below the ceiling permitting some light to escape and illuminate the surrounding ceiling area. C. A rectangular box centered in the coffer. D. Small boxes in the corners of the recesses. Here a suggestion for grille work on the splayed sides covering the ventilating openings is also shown. E. Small lamps in a narrow trough around the edge of the opening lighting the coffer indirectly. F. A single lamp in an inverted bowl shape reflector supported at the center of the opening by a series of vertical fins. G. The opening covered by a series of diffusing glass rings arranged in a step formation with lamps mounted around the edge. H. The sides of the coffer made of ornamental cast glass. Ventilation is accomplished thru the openings thus provided. Lamps and reflecting equipment are placed behind the glass.

Luminous Columns and Pilasters

Analagous to the light box is the luminous column or pilaster. Generally speaking, this is more ornamental than utilitarian, and is an effective means of decorating an interior.

Diffusing glass, white or tinted, is now available in blown cylindrical forms. Standard lengths of these cylinders may be held together by simple binding strips and rows of lamps placed within. Sections of pressed glass may be combined to form cylinders. An interesting decoration can be pressed in the glass. Other diffusing media may be attached to wooden or metal frameworks and used

These ceiling coffers in the Terrace Restaurant of the New Yorker Hotel have small enclosing glass boxes in the four corners of the recesses. Ventilation is provided through the grille work at the sides.

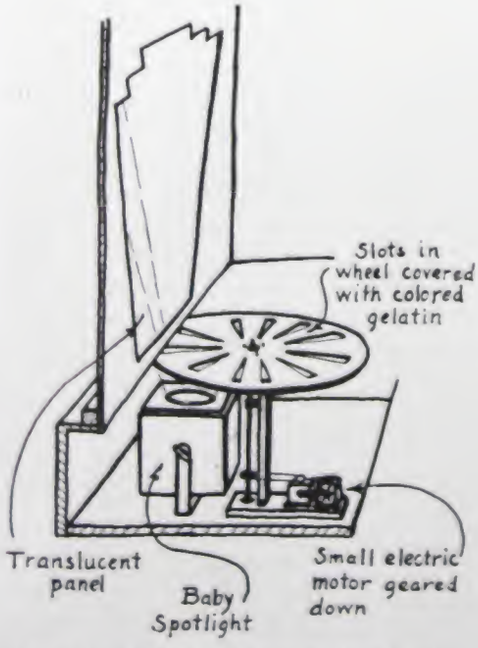
The coffers in the ceiling of the elevator corridor of the Navarre Building have the sides finished in brilliant colors. In each pocket is placed an etched glass box approximately 1 x 2 feet and 8 inches deep supported by four decorative metal arms. Each unit contains five 25 watt Mazda lamps. The colorful sloping sides are thus brilliantly illuminated and create a striking effect.

to form the desired contour as shown in some of the accompanying illustrations, the captions of which give details.

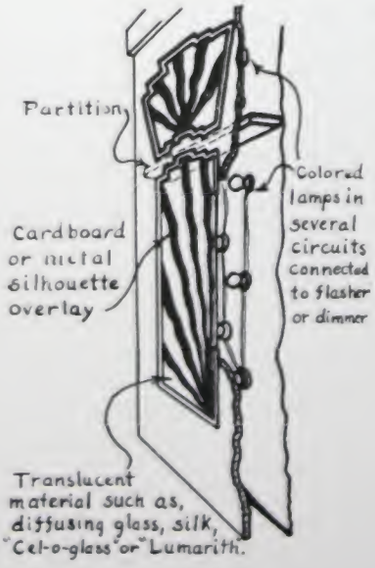
It is often desirable to illuminate these columns in color and striking gradations of tint may be secured by the application of different colored lamps in various sections. Shadow effects produced from within also find application. Some of the means of securing these in simple manners are pictured in the sketches.

Illuminated Surfaces

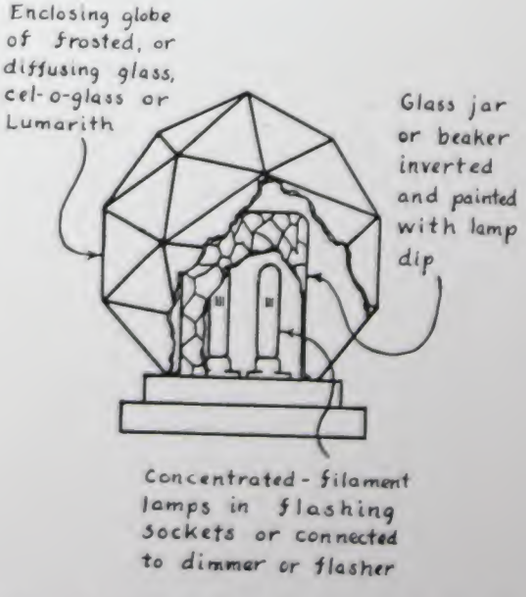
When colored light strikes a surface the latter by reflection takes on the color. If, therefore, small boxes, compartments or the like be so arranged that they are illuminated from concealed colored lamps, an infinite variety of effects is possible. In one of the pictures is indicated an arrangement for producing a checkerboard design around a doorway. In another, the ceiling of a small compartment is made to assume a color pattern. The



Scheme for lighting a luminous panel, column or pilaster with moving shafts of colored light.



A means of illuminating a translucent panel or pilaster in changing colors.

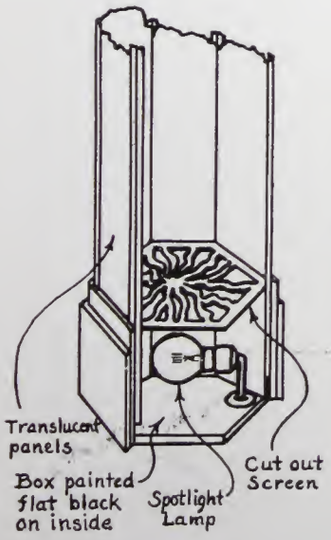


A simple device for producing an ever changing mottled color effect in enclosing globes and boxes.

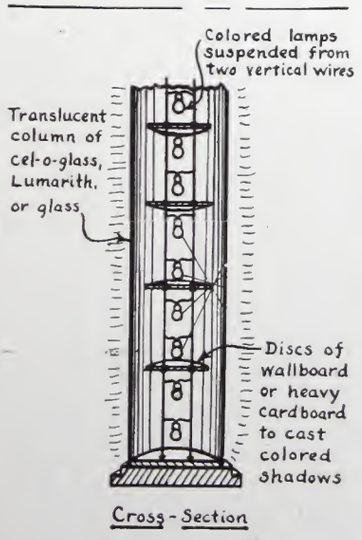
Left: An inexpensive design of luminous box for corner mounting. A framework of wooden strips painted black support sheets of white or opal Lumarith. Two circuits of receptacles on 6 inch centers supply respectively canary and amber-orange 25-watt Mazda lamps. In the box at the top is placed a mirrored glass angle reflector with 200 watt Mazda lamp and amber glass color cap for general indirect lighting. The two colors used within give quite different luminous effects, both of which are pleasing and "livable."

Center: A simple luminous column made up of cylinders of diffusing glass held together with metal binding strips. A luminous pilaster made up of half cylindrical sections of blown yellowish tone opal glass (Macbeth-Evans Cremax).

Right: A short luminous column surmounted by an inverted modernistic enclosing globe, with changing color effects. As shown in the detailed sketch, this has a hexagonal base and top each about one foot high, finished in copper and nickel. In both top and bottom is a shadow producing arrangement, as indicated in the detailed drawing. The central section is approximately four feet in height and made of amber Lumarith. This is supported by a nickel plated corner frame to which cutout decorations of brass are attached.



An arrangement for producing fantastic shadows in color on luminous columns and pilasters.



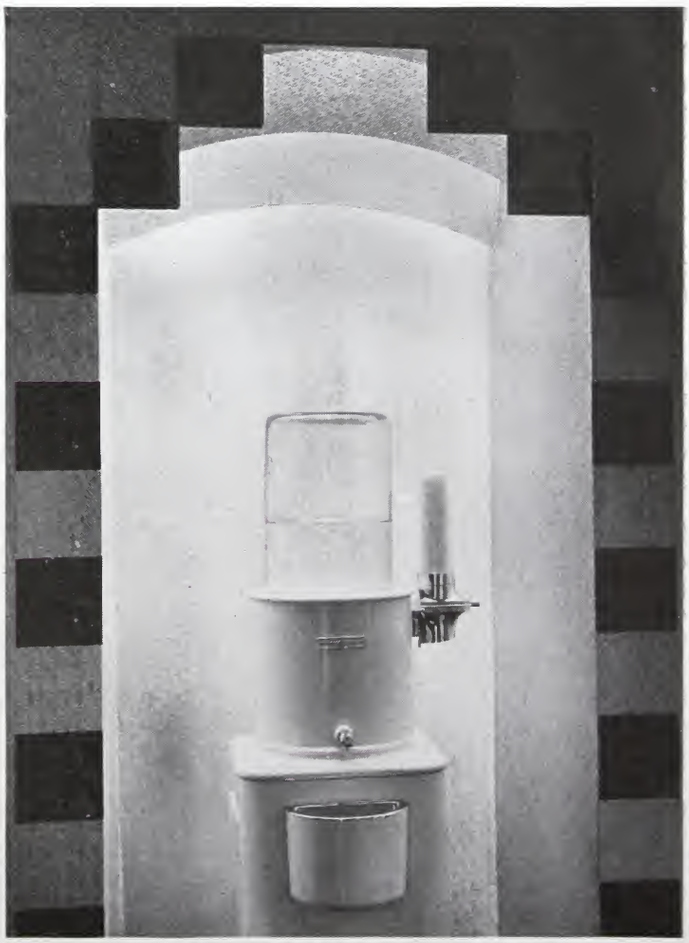
Suggested scheme for lighting a luminous column in layers of color.

sketches suggest still other variations of this basic idea.

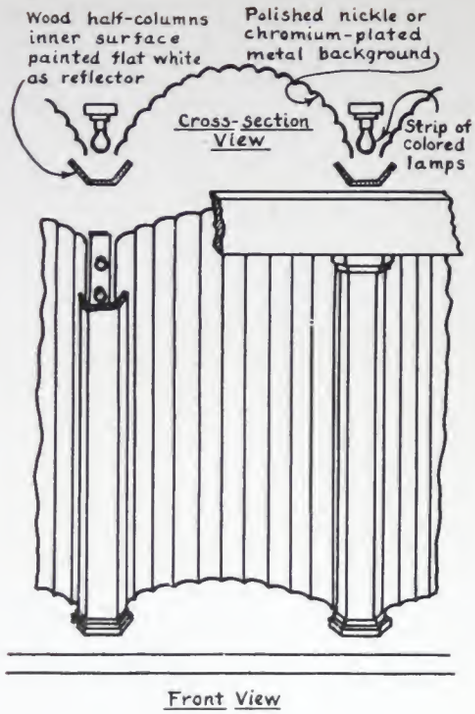
Color Shadow Effects—"Colorama"

Of course, some of the systems of essentially decorative lighting do furnish quite an appreciable amount of general illumination. One system falling in this category has been termed the colorama. The first and outstanding illustration of this very ingenious and most interesting lighting system was in the Hotel St. George in Brooklyn, N. Y., which installation is described in detail in the January, 1930 issue of LIGHTING. The magnitude of this can be pictured when one realizes that over 6000 incandescent lamps are used with a combined wattage of more than 530 kilowatts in a room of less than 10,000 sq. ft. area. The colorama utilizes the principle of inserting an opaque object in the path of colored light rays and causing a shadow to be cast, then illuminating this shadow with flux of some other color.

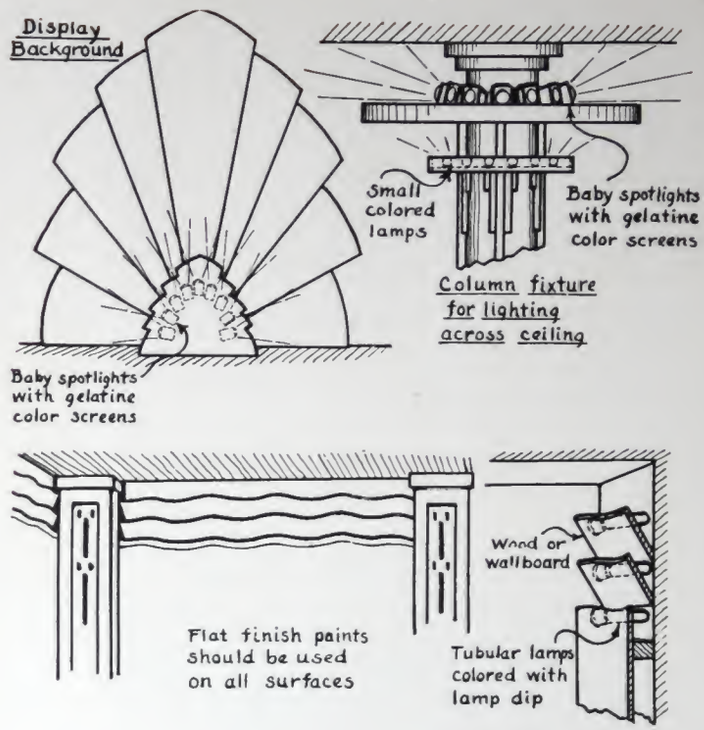
By varying the shape of the shadow casting screen and its position relative to the lamps, an infinite variety of patterns are possible. These, combined with flexible control of the colored light sources, give an everchanging display of tinted geometric forms on the wall, cove or ceiling of the room in which the colorama is placed. It is impossible in the space available to discuss the details of such a layout, wattage of lamps, etc., but the reference cited presents these features of a practical and operating example.



An illuminated niche for a water cooler. This is finished throughout with aluminum foil paper in a watered silk design. The sloping top is made of three planes or fins of composition board set at an angle. Above and between these are circuits of red, green and yellow Mazda lamps. Each circuit in each section is individually controlled, permitting an infinite variety of color effects. All one color may be used or alternate stripes of different colors at will, or any mixture.



Simple arrangement for illuminating a polished metal background in color. When this is viewed from different angles interesting changes ensue.



Above: Scheme for obtaining brilliant fans of colored light on ceiling or ornamental vertical area.

Below: A suggestion for producing a color lighted border for a room, at the same time obtaining indirect general illumination.

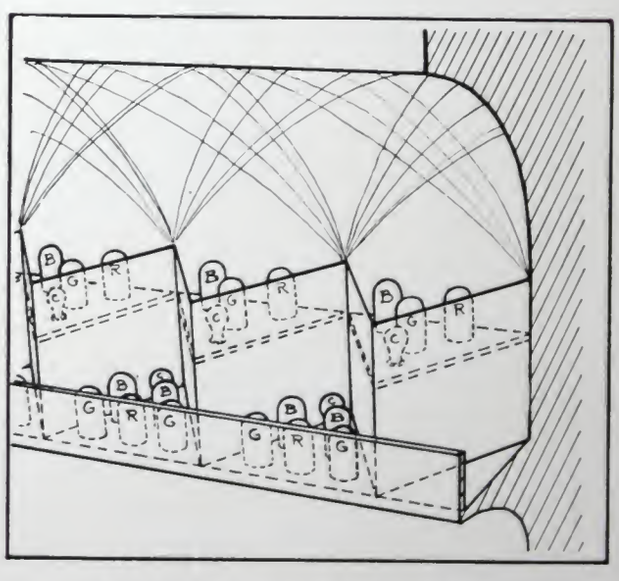
Color shadows can also be produced on translucent material and all sorts of forms may be used to produce these. One of the illustrations shows an application to the ripple glass on a store front, and the sketch indicates how the component parts are arranged.

Projected Light Patterns, Luminous Flowers, etc.

Everyone recalls from his boyhood days the old experiment with the so-called pin hole camera. If a room is made totally dark and then a very small hole made in one side, there will be projected on the opposite wall an inverted picture of the scene out-of-doors. This is a result of the straight line travel of light rays.

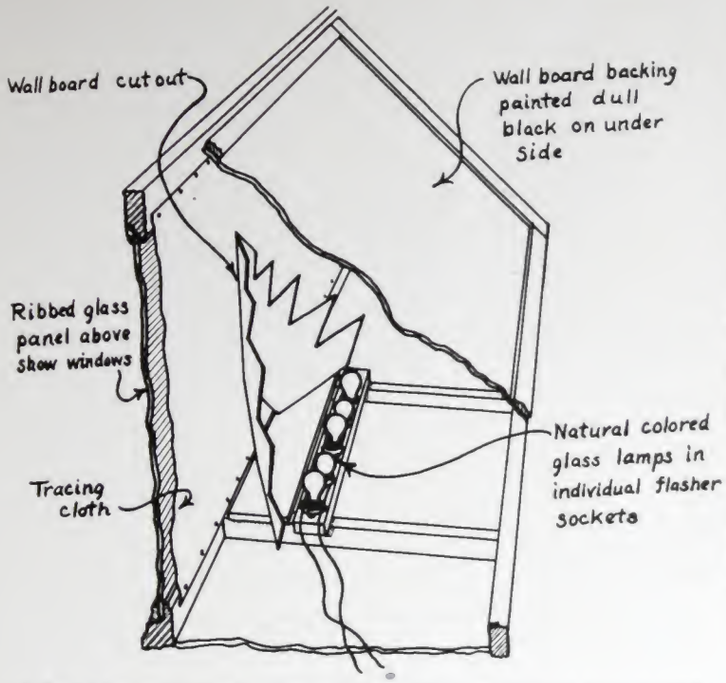
If we take a black box and in it place a concentrated filament lamp which approximates a point source, the light emanates in straight lines, there is no reflection from the inside of the box, and there will be projected on the wall or ceiling a copy of any design which may be cut in the top of the box. In the theatre the top of such a box is covered with a piece of glass on which a scene is painted in transparent dyes and the device is named after its inventor, the Linnebach lamp. This principle has recently been applied for producing "light flowers" for decoration in interiors. A cove of suitable dimensions is provided, painted black on the inside. In this are properly positioned concentrated filament Mazda lamps and the top of the cove is covered with a cutout pattern of a suitable design. A typical stencil casting a fantastic figure is shown in one of the accompanying sketches. Here two pieces of glass have placed between them a piece of black paper cut as indicated and pieces of gelatin used for the color. Patterns of unmodified light may be obtained through the use of a simple stencil design cut in thin wood or beaver board.

There are innumerable variations to this general idea of projecting light patterns. For instance, to obtain the effect of grass, a number of curving slits may be cut as a



Sketch showing details of one form of colorama.

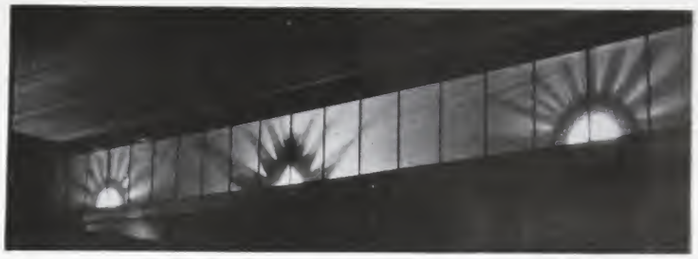
Demonstration model of two types of colorama sections.



Scheme for producing color shadow effects on rippled glass above show window.

stencil. These are covered with green gelatin or glass and a row of lamps placed in the black box. Each lamp casts its individual projection of the slits and there results an interlacing, overlapping pattern. This design may be combined with stencils of flower shape lighted by separate lamps in individual compartments. By connecting these lamps to a dimmer control, at one time a meadow may be alive with yellow daisies. These fade out and red roses take their place. These, in turn, are dimmed and blue violets appear. Then the cycle is repeated.

By mounting plane mirrors beside the concentrated filament lamp, a single stencil may be projected to several positions, for the reflected images of the lamp filament act as secondary sources.

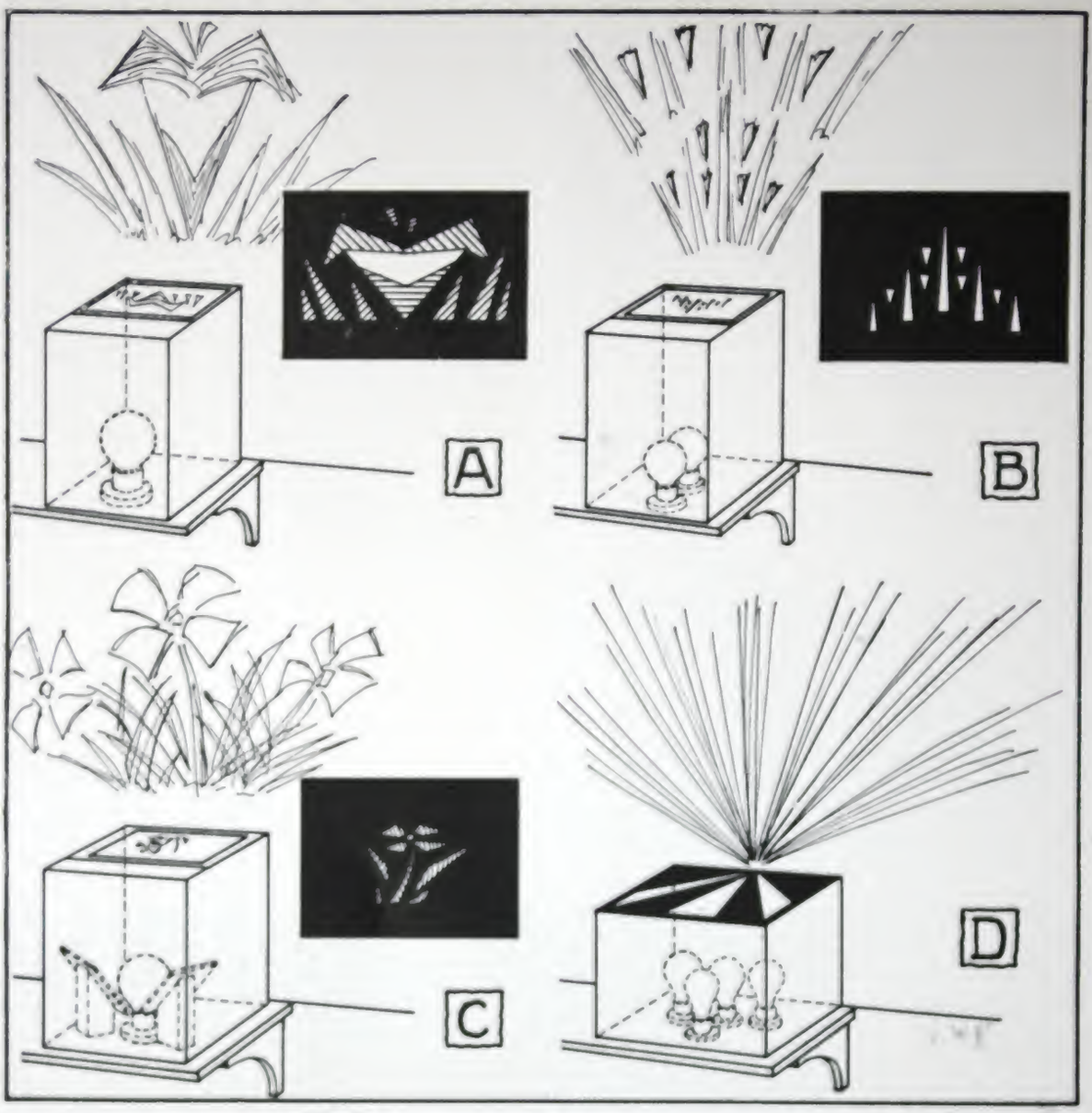


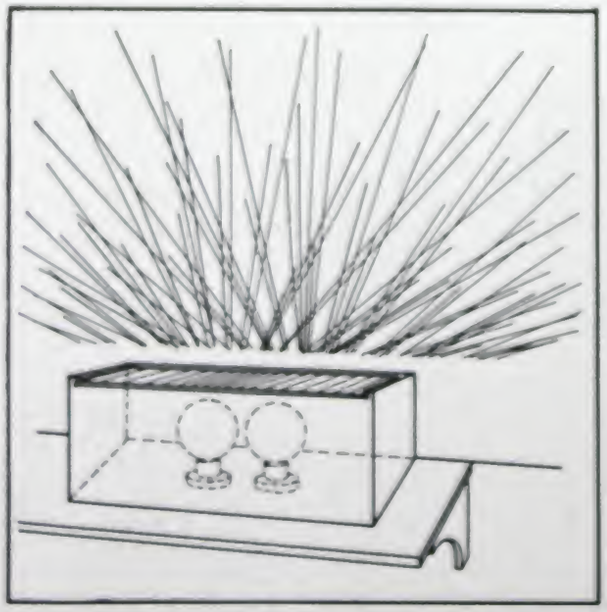
Color shadow effects used on the rippled glass above the show windows in a small store.

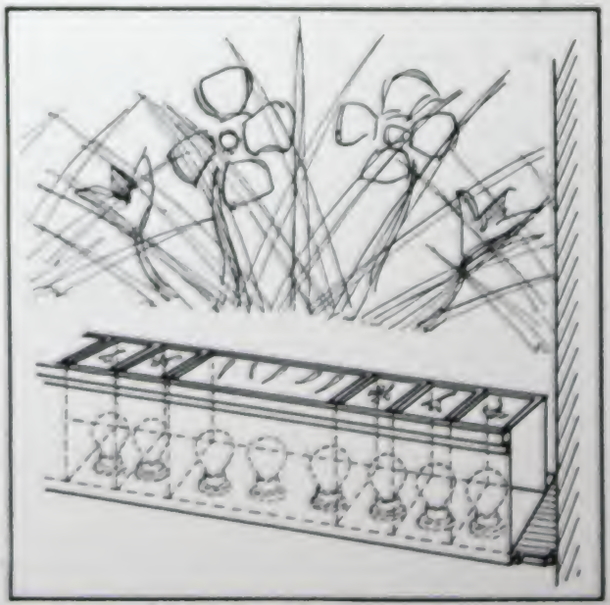
These projected designs may be built on a rather small scale for installation around the capitals of columns and pilasters. A satisfactory design has been worked out with a maximum distance from the column to the ouside of the cove of less than 7 inches. In this, automobile headlight lamps are used, fed through a 6 volt transformer.

For a permanent installation, thin sheets of natural

Installation of the colorama or color shadow effects on a huge scale in the St. George Hotel, Brooklyn.







Above: Sketches showing some of the possible arrangements for obtaining projected light patterns. A. Single lamp with geometric cut-out using colored gelatin. B. Two lamps on flasher sockets with simple composition board cut-out. C. Flower stencil with single lamp and twin mirror arrangement for producing multiple images. D. A group of lamps on flashing sockets with cut-out slits.

Lower Left: Sketch showing details of a simple box for producing changing aurora effects.

Lower Right: Sketch showing suggested arrangement for obtaining changing luminous flowers on a background of projected foliage.

colored glass are preferable to lamp dip or gelatin for obtaining color on account of the permanency of the former. For the stencil thin copper about .002" works very well for it can be cut with a sharp heavy knife, such as used by surgeons. It is generally desirable to have the stencil face at right angles to a line of projection. The G or P bulb concentrated filament lamps seem to work out better than the tubular lamp.

Still another variation of this general idea produces a fan or aurora borealis of colored light rays which may be stationary or moving. For this effect two flashing sockets are placed in a black box the mouth of which is covered with a sheet of flat glass on which have been painted stripes of lamp dip or transparent colored lacquer. These bands should be about 1" wide of red, yellow, green and blue arranged in a haphazard fashion. If the box is inclined a slight degree toward the area to be lighted the bands of color will be projected on it. As first one lamp then the other flashes on and off a wave or motion is secured.

Luminous Grille Work—"Light Mosaics"

Some very pleasing decorative light effects are secured through the use of parallel planes of pierced work or grilles. These can be made of punched metal or composition board, painted white. Rows of colored lamps are used to light the face of these grilles. The first plane may be lighted in blue, the second plane in green, and the third plane in red. As one looks at such a decoration from different angles, the colors blend into a marvelous mosaic. Several circuits may be used and changing colors produced. By the use of this arrangement a border or frieze of a very interesting and luminous character can be secured.

An interesting variation of the general scheme employs a grille or plate of glass cast with ornamental openings. This may be tinted and etched. Such a plate is mounted in a box with a white background and two rows of lamps provided. When the front row is lighted the surface of the glass shows up by reflected light and fantastic shadows are thrown on the background. When the rear set of lamps are turned on, the background is bright and the glass made luminous by transmitted light. Here, also, various color combinations can be worked out.

Recapitulation

We have indeed seen a remarkable change in our living conditions since the advent of the twentieth century. Speed and industrialism are keynotes of the age. In the memory of all of us the horse has been superseded by the auto and enthusiasts say that the aeroplane is about to make the latter obsolete. Mass production in the factory and even in the building trades has replaced hand labor. We were due for a change in our decorative style as a result of economic conditions.

Now as to the lighting phase of this whole movement. Illuminating engineers have been preaching for years that modern light sources were not "getting a square deal." The designer, hide-bound by tradition, was constantly copying classical forms and subjecting the incandescent lamp to all the limitations imposed on flame illuminants. It has been said on thousands of occasions that it is positively ridiculous to put a lamp giving from 20 to 60 candlepower on the top of a paper tube and endeavor to use it in the same manner as the weak, flickering candle was employed. It remained for the French artists, decorators and designers, with their inherent sense of the fitness of things, to appreciate the folly of such a method of procedure, and as early as 1924 they began to use incandescent lamps in a radically new, unique and rational fashion. They realized that it was safe to put a lamp in an enclosing box if they desired; to place it in a wall niche and cover the opening with a piece of diffusing glass; to make an artificial window where appropriate; to have small cups

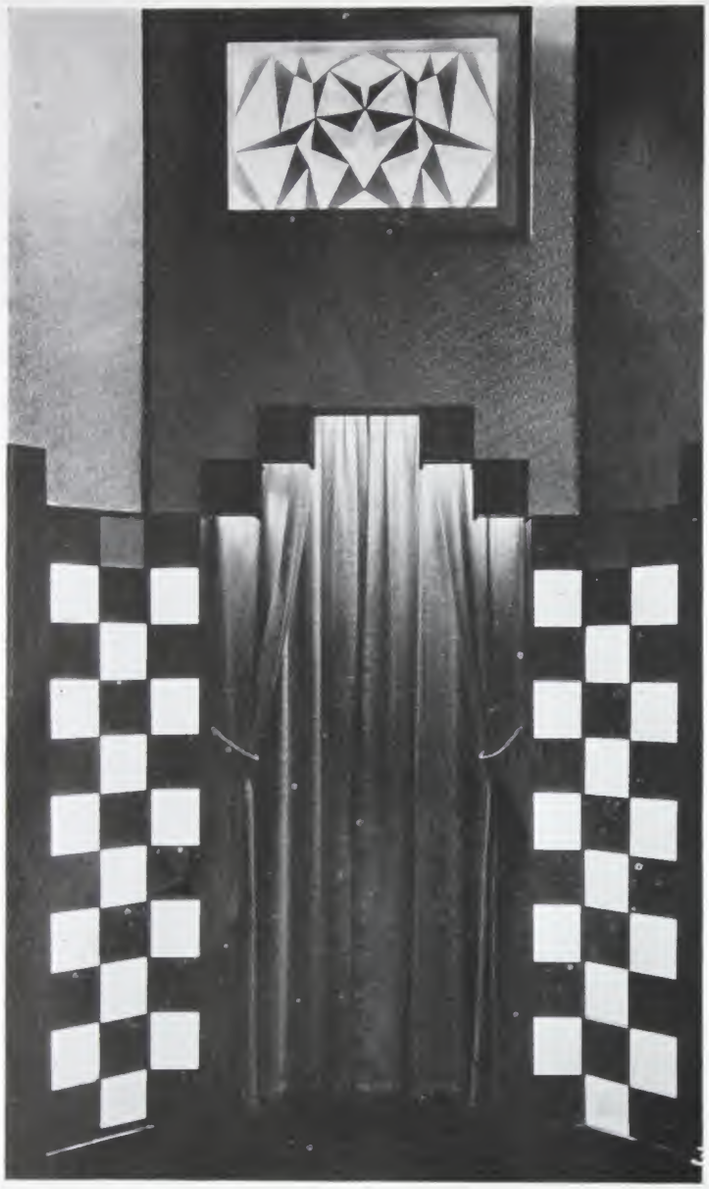
Models designed to show some suggested arrangements of projected light patterns and luminous flowers.

Projected light patterns form an interesting scheme of decoration in this meeting hall.

on the side wall to reflect the light upward and outward rather than in the old candle fashion, and evolved many exceptionally interesting designs. The Paris Salon of 1924 displayed quite a collection of these new luminaires and the Exposition of Decorative Art in 1925 was literally filled with examples. Unquestionably this movement would have started several years earlier if we had not had the World War and its period of recovery.

Several leading American artists, architects, designers and decorators who visited the Exposition at once saw the application of this new treatment of light to American conditions and we have now hundreds of excellent examples in this country.

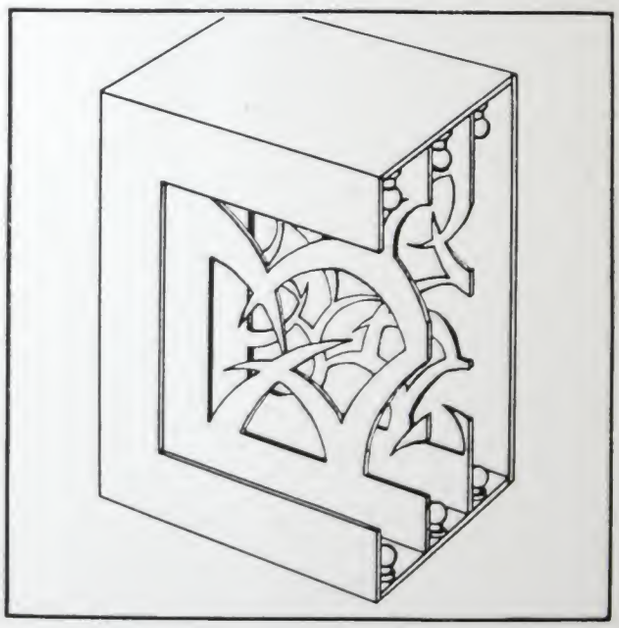
There is a tendency on the part of the uninformed to think of something as art moderne if it is made up of planes of frosted glass arranged in rather bizarre geometric designs. This is just one phase of the whole movement and will be either radically improved or will pass out of the picture. The true significance of this movement applied to lighting is that it uses a modern light source, the incandescent lamp, in such a manner as to obtain full benefit from its inherent qualities and does not handicap it by traditional forms. From this viewpoint our indirect lighting systems are as modern as the most fantastic plate glass box. Some of the enclosing units designed especially for a given lamp are truly modern.



Above: Small box containing a luminous grille. The background is solid and painted white. Two planes of composition board are cut with a fantastic design and painted white. 10 watt red, green and amber Mazda lamps are arranged on three circuits and placed in front of the first grille between the first and second grille and in front of the background. By manipulating switches or dimmers the different planes assume various colors.

Below: A series of indirectly lighted boxes are used for the decoration around this doorway. The squares are 5½ inches on a side. The background of the box has a curved form and is finished in aluminum. Mounted well out of sight are three 10 watt S-11 bulb Mazda lamps, red, yellow and blue, each circuit controlled independently. A glossy black finish is used in the spaces not made luminous.

The draped light tan curtains of Monk's cloth are also made luminous by rows of colored lamps in small mirrored glass reflectors above the doorway. The back drape becomes gold or yellow, and the front hangings are striped in red and green.



Sketch showing arrangement of lamps and cut-outs in light mosaic.

Different designs of cast ornamental glass made by the Stueben Works of the Corning Glass Company are used for this bit of light decoration. The glass is mounted on a framework within a box which has a white background. Colored lamps on several circuits in front of and behind the glass produce delicate combinations of tint.

This booklet reprinted from LIGHTING, *November, December,* 1930: *January,* 1931.